

***PATENT***

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re application of: Dingyi **HONG**, et al.

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For: METHOD FOR PREPARING BISPHENOL A

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**DECLARATION UNDER 37 C.F.R. 1.132**

# INVENTOR'S REMARKS

I, 周继东(Zhou Jidong), one of inventors of this invention, now provide following remarks about this invention over the four cited references cited in the final OA:

I majored in chemical engineering and graduated from Beijing University of Chemical Technology in 1984, and received the Master degree of Chemical Engineering from Beijing Chemical Engineering University in summer of 1995.

I worked in Research Institute of Beijing Yansan Petrochemical from 1984 to 2005, engaged in the design and development of chemical engineering. From 2005 to 2006, I worked in engineering department of Sinopec Co. as professorate senior engineer. From 2006 to now, I work in Beijing Research Institute of Chemical Industry, as deputy director of Production & Technology Department, and undertake the design and development of chemical engineering.

I have published dozens of papers, applied 14 items of Chinese patents and gained twice Technology Advancement Award of Sinopec Co. I have profound theoretical knowledge and well experience in design of chemical engineering.

## 1. Regarding Okamoto et al. reference (US5087767):

In the final OA, this reference is deemed to teach that the water generated during the preparation of bisphenol A must be reduced.

However, according to the invention of this application, the stream comprising bisphenol A obtained after reaction is processed outside of the reaction zone, then the fraction returned to the reaction zone would comprise less water and bisphenol A than the reaction stream, thus, less reaction products will be brought back so that to facilitate the continuation of the reaction of acetone and phenol. Thus, according to the invention of this application, the catalytic activity of the ion exchange resin is not the only one being concerned.

According to Okamoto et al. reference, the pervaporation is conducted within the reactor in following two manners:

- 1). Under reduced pressure and usual temperature, thus, a vacuum condition would result in complicated operation; furthermore, the membrane used therein is with limited capacity for separating water; then this method is merely suitable for a batchwise stirred reactor rather than a continuous fixed bed reactor.
- 2). under usual pressure and high temperature, thus, the water vapor could pass the membrane; however, the high temperature may deactivate the catalyst quickly.

According to the invention of this application, the reaction stream is distilled outside of the reaction zone to obtain a water depleted fraction to return to the reaction zone. Viewing the technical effects, since the water depleted fraction has a water content of not greater than 2wt%, the reaction selectivity and acetone conversion were improved significantly.

Although both the invention of this application and Okamoto et al. reference conduct water reducing operation, their purposes and processes are different from each other. At least, removing water with membrane and distilling out water with rectification column is different significantly.

2. Regarding Kwantes et al. reference (US4308404,JP54-019951):

It has to be noted that the fraction to be recycled to the reaction zone in this invention is different from that in Kwantes et al. reference. According to the invention of this application, the final reaction effluent is further processed to obtain the water depleted fraction to return to the reaction zone, more specifically, the reaction stream obtained after reaction is transferred into a rectification column, then a water depleted fraction primarily comprising phenol, bisphenol A and acetone is withdrawn from the rectification as a side draw in liquid, cooled via heat exchanger and returned to the reaction zone. After being cooled, the recycled water depleted fraction can decrease the reaction temperature; thus, prevent the deactivation of the catalyst due to high temperature.

Comparisons between the invention of this application and the Kwantes et al. reference are listed in following table:

	According to this invention	According to Kwantes et al. reference
Source of recycled fraction	Distilling final reaction effluent in rectification column and withdrawing as a side draw in liquid	Recycling Intermediate reactor effluent as such
composition of the recycled fraction	water and bisphenol A being reduced over the reaction effluent	Same as the reaction effluent
Technical effects	Facilitating the continuation of the reaction due to less water and bisphenol A The cooled water depleted fraction decreases the reaction temperature, thus, prevents the deactivation of the catalyst due to high temperature The water depleted fraction in liquid can save the energy for cooling the same The acetone conversion can be more than 80%.	In Examples 1-4, the acetone conversion of first reactor is about 40%, and the acetone conversion of second reactor is about 60%.

3. Regarding TayLor et al. reference (US2486342):

The invention of this application is aimed at obtaining a side draw in liquid by distilling the reaction stream rather than recovering phenol and the recycled fraction is not obtained via evaporation.

TayLor et al. reference discloses a process for recovering phenol by distillation, wherein the top fraction primarily is the azeotrope of water and phenol, and the bottom fraction primarily is anhydrous crude phenol. Thus, TayLor et al. reference teaches neither recycling a fraction to the reaction zone nor withdrawing a fraction as a side draw.

4. Regarding Hachiya et al. reference (US6277945):

In Hachiya et al. reference, the mixture of bisphenol A, phenol and water is separated only, no dewatering is conducted. However, according to the invention of this application, the side draw has reduced water content.

**Conclusion:**

1. According to the invention of this application, a distillation outside of the reaction zone is conducted, thus, the reaction temperature can be controlled regarding the catalyst activity. However, according to Okamoto et al. reference, a pervaporation within the reactor is conducted to removing water therefrom, thus, a vacuum is required and the temperature had to be determined by the bubble point of the water, being not favorable to the catalyst activity, which requires initial lower temperature and subsequent higher temperature: furthermore, the vacuum results in complicated operation surely.
2. According to the invention of this application, withdrawing as a side draw from the rectification column not only reduces the water content, but also reduces the bisphenol A as well as the heavy components: furthermore, the liquid water depleted fraction can save energy for cooling the same, thus being superior over the gaseous top fraction, which is an azeotrope of water and phenol with high water content, in the prior art. And the water depleted fraction is superior over the intermediate reaction effluent being recycled as such in Kwantes et al. reference too.
3. None of those four references disclosed or suggested the side draw in liquid from the rectification column distilling the reaction stream comprising bisphenol A being recycled to the reaction zone.

Finally, I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity or the application of any patent issued thereon.

Date: 2010-8-16

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